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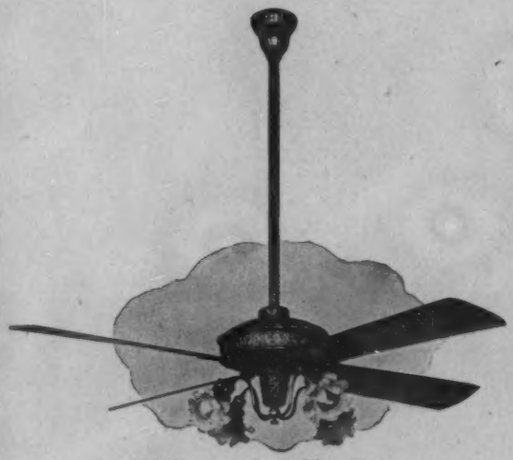

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VOLUME XVIII. SAN FRANCISCO, CAL., APRIL 6, 1907 No. 14

Unique New Swiss 40,000-Volt Switch and Automatic Relays.

The accompanying illustrations and drawings show the details and method of construction of a new 40,000-volt automatic switch and various types of relays which are of the greatest importance at the present time in high tension power transmission work. These switches and relays were designed and constructed at Baden, Switzerland, by Brown, Boveri & Co., Ltd., and many similar devices are now employed in important power generating stations in America.

For many years past in order to prevent any dangerous overloading of machines, apparatus and cables, easily fusible metal strips calibrated to carry the normal working current and generally fusing with double the working current strength, were inserted in the leads. Originally, when only small current strengths came into consideration, this arrangement sufficed, but with the growth of engineering, the output of machines increased, and at the present day when machines giving 1,000 horsepower and more are built many difficulties arise through the adoption of fuses. If dealing with heavy currents of medium voltage the dimensions of the fuse strips are considerable and the calibration is inaccurate, as the current strength required for melting the strips largely depends on the conditions of ventilation. The fuse is inaccurate also on account of the time which elapses from the beginning of the overload to the melting of the fuse simply depends on previous working conditions. When the conductor is only very slightly loaded the fuse remains cold up to a certain instant. If a large overload is now suddenly thrown on, a fuse with large dimensions requires considerable time before its temperature reaches the fusing point to make it blow.

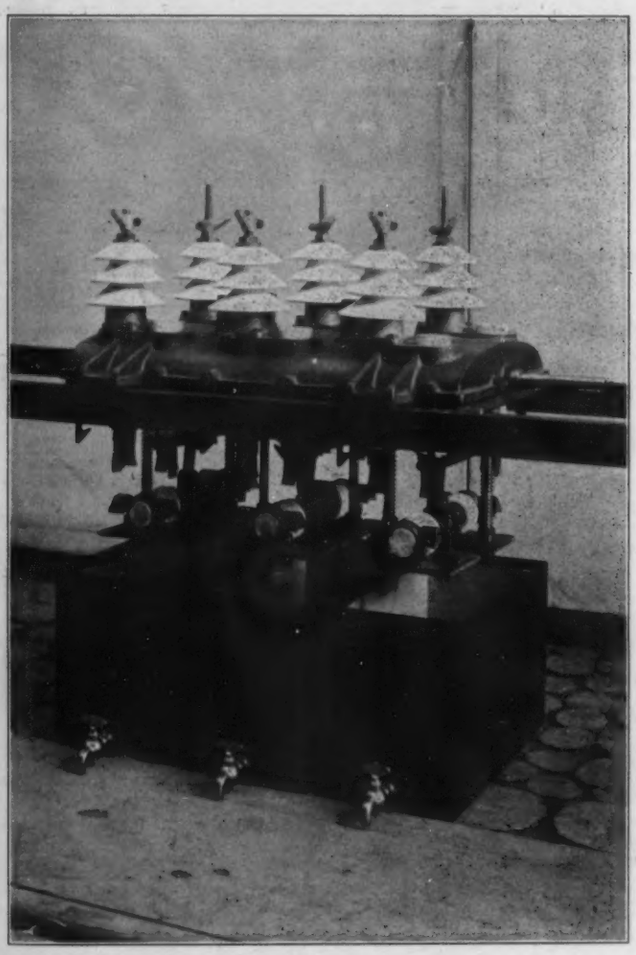

Fig 1. Swiss 40,000-Volt Automatic Oil Switch

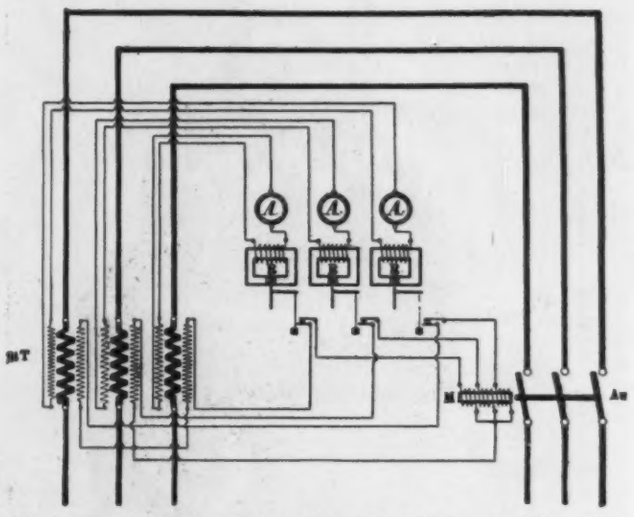

Fig 2. Connections of Swiss Automatic Switch with Three Pole Overload Relay with Alternating Current Triping Solenoid.

St. T.—Current Transformer. A.—Ammeter.
R.—Overload Relay M.—Tripping Coil.

In case the conductor is carrying the normal current when the same overload occurs, it will have a certain temperature higher than in the first case and will burn out much quicker. The fuse therefore only serves the purpose of protecting the machine against a dead short circuit and this in a rather unreliable manner since the glowing metal, caused through the fuses burning out, help to maintain the spark. This is often ruinous to the fusing apparatus when special arrangements are not made to carry away the fumes from the leads and apparatus, and render the gases harmless.

It will also be noted that considerable time is lost placing a burnt-out fuse, and last of all one must not forget the cost of

fuses for large current strengths. All these unfavorable conditions multiply in high tension plants when working at from 10,000 to 40,000 volts and more.

In many large European plants fuses are entirely done away with. In low tension installations it has, however, been possible for some time back to do away with fuses by making use of maxi-

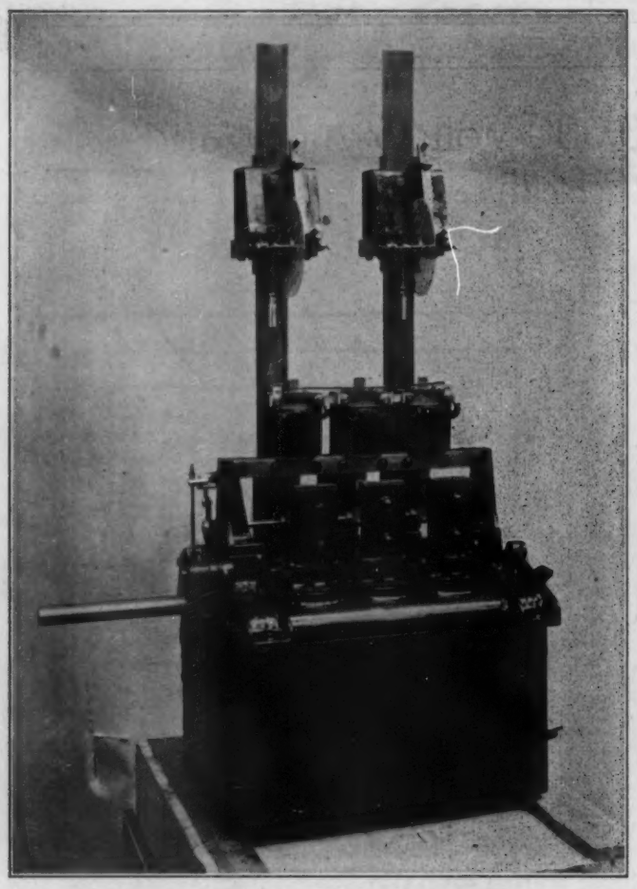

Fig. 3. Swiss Automatic Oil Switch with Overload Current Relay and No Voltage Relay.

mum current automatic cut-outs, which are operated by means of solenoids, through which the main current flows. This apparatus has its disadvantage, for it operates instantaneously with an overload of the smallest duration, a point which is, however, not desired, since it causes unnecessary interruptions in the service.

The Swiss engineers hold that when they set out to design a new automatic switch to replace the fuses, they had in view principally high tension installations. For well-known reasons, it was impossible to make use of high tension alternating currents in the solenoid portion of the switching apparatus. The choice of the type of switch was in itself not a matter of the least importance, for the same had to possess such properties as to be able to cut out the largest outputs on short circuits without difficulty and without disturbing the supply. These designers were led to make use of the oil switch, which had given entire satisfaction and which could be easily employed for automatic operation by making a few changes in its constructon.

A 40,000-volt three-pole automatic oil switch of this type of Swiss design is shown in the illustration, Fig. 1.

In designing the releasing arrangement the Swiss engineers claim to have held firmly to the point that the same should be placed where it was visible and at the same time easy to get at. On the other hand, it is the practice in high tension plants to mount the high tension switches outside of and independent from the service switchboard. These switches are operated by means of a transmission gear from the service switchboard, which only contains the measuring instruments carrying low tension current (transformer down) and the driving hand wheels. It was considered necessary, however, to separate the apparatus which was to be used to release the switch from the switch itself and to mount it on the service board. A tripping coil is mounted on the switch, which is electrically worked by the above named apparatus from an auxiliary current supply.

It must be mentioned that this relay must be operated by the supply current available. While on the one hand, however, all high tension currents were on principle kept separate from the service switchboard, and as it was also difficult to design a high tension relay, it was decided to make use of the current transformers provided for the ampere meters to supply the required low tension currents for the relays. It is well known that during actual service in an electric station small overloads sometimes occur, which, if they only last a short time, are not dangerous to the machines. In such a case an automatic switch is provided, which switches out after a certain length of time; i. e., when the overload begins to become dangerous for the machines. On the other hand, short circuits can take place which ought to be removed at once, and between these two cases every possible condition of overload exists for which a corresponding time for switching out seems necessary.

It is stated that the action of the automatic overload relay is based on Ferrari's well known principle. A light aluminum disc is arranged to revolve between the poles of a laminated electro-magnet. The electro-magnet is energized by alternating current taken from the secondary side of a transformer, the secondary current being proportional to the main current of the machine. The necessary rotary field to produce the torque on the disc is obtained in a very simple manner by adding a short circuited copper ring to cover half the cross section of the magnet. In this way one obtains two alternating fields differing in phase, these two fields giving a resultant rotating field which sets up Foucault current in and induces a torque on the aluminum disc. The spindle of the disc is horizontally pivoted and carries a small drum on which a silk cord with a weight suspended at the end is wound up.

Up to a predetermined current strength at normal load the weight prevents the disc from turning. If the working current now exceeds the prearranged figure, the torque on the disc increases and the cord with the weight suspended at its end is wound up on the drum.

As soon as the weight rises a certain height, it closes a circuit by bringing together two very light contact springs arranged in a horizontal position. A strong permanent magnet, between whose

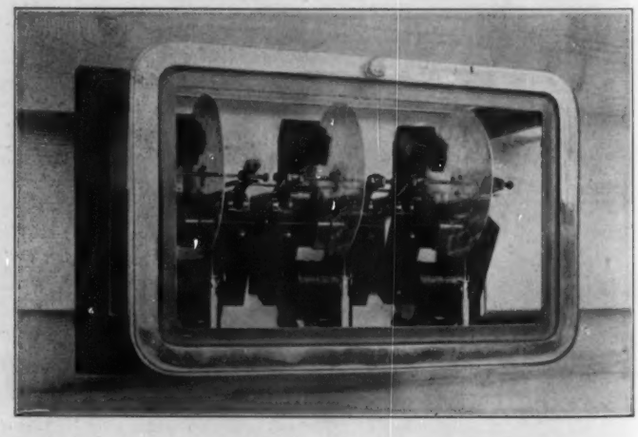

Fig. 4. Swiss Three Pole Reverse Current Relay.

poles the aluminum disc rotates, serves to damp the action of the disc and prolongs the time taken in lifting the weight. The contact springs are connected to the circuit of the tripping solenoid arranged on the switch. When the contacts are brought together the solenoid attracts its armature and the main switch, due to its own weight and to the action of the springs, operates.

About two amperes is the tripping current, and this is taken from the exciters, or from a small accumulator battery.

It will be noted that the length of the cord on which the weight is suspended the time limit may be varied, and by adjusting the weight itself the current at which the time limit device should commence to operate can be varied. The time which elapses from the moment the disc commences to rotate until the circuit for the solenoid is made depends also on the extent of the overload, so that the time is long when the overload is small and short when the overload is large.

It is stated that the time required in switching out is a function of the overload current strength. The times plotted down are not fixed quantities, as they can be adjusted in each relay as desired, even when the relay is in circuit, by increasing or decreasing the length of the silk cord to which the weight is attached. The apparatus is calibrated for an overload current of 1.4 times that of the normal working current. This adjustment of the overload can be carried out on any relay and at any time. The counter weight consists of eight brass discs or washers and a brass nut, and by removing the single discs the tripping current, i. e., the current to operate the relay, can be reduced to under one-half of its original value.

It is maintained that for various normal working currents the ratio of transformation of the current transformer is altered so that the secondary current is always 1 ampere when the pointer of the ampere-meter gives its maximum deflection, this latter

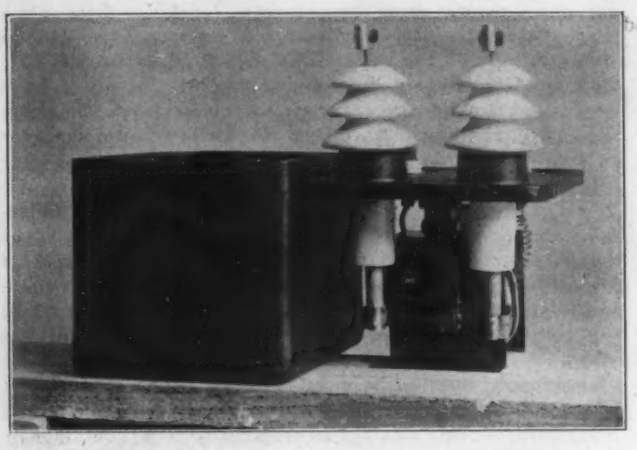

Fig. 5. Current Transformer for Feeding Relays.

being usually selected so that it is about 30 per cent above the normal working current. Every relay has this current strength, i. e., one ampere, and the same relay can be employed for any circuit, providing that the corresponding current transformers are made use of, no matter what the current strength in the circuit may be.

The usual relay employed is single pole, but same can be connected up to form two or three pole relays, if required. In single phase installations a two-pole relay is generally employed; a single-pole relay is, however, sufficient. In two-phase installations two-pole, and in three-phase installations two or three-pole relays are used. In three-phase plants with a neutral, a three-pole relay must be adopted. The tripping contacts in the multi-pole arrangements are connected up in parallel.

Of course, with the apparatus described above it is necessary to have continuous current for the tripping coil of the switch. Continuous current is always available in a central station, but on the other hand, it can happen that this current is not at one's disposal, as, for instance, in a transformer substation, and to obtain which one prefers not to employ an accumulator battery. For such cases these Swiss engineers have designed a tripping device to be operated with alternating current.

As is well known, it is not possible to actuate the tripping coil by employing a tension transformer only fed from the network, for at the very instant that the relay should operate, for instance, on a dead short circuit, the drop in the voltage is very great or the tension disappears altogether. The tripping device must, therefore, on this account be actuated by a current transformer.

On a three-phase system it might occur that the overload or short circuit occurs on one phase only, and it is for this reason necessary to feed the tripping device from at least two phases of the system. As current transformers are always available for the standard type of overload time limit relays, the former can at the same time be employed for the tripping device by winding a second coil on the core of the current transformer. This winding generally remains open, but is switched onto the tripping coil mounted on the main switch by means of the time relay as soon as the latter starts to operate, so that the mechanism of the tripping device opens the switch.

It is maintained that in order to keep the phases separate from one another, two or three seperate tripping coils mounted on the core of the tripping device are employed in connection with a two or three-pole relay respectively. As it is neccessary to only know the current flowing in one phase of the system, this can be done by observing the ammeter in that phase, a two-pole relay in conjunction with only two current transformers is sufficient for a three-phase system, provided, of course, that the neutral point is not earthed. In this latter case, however, a three-pole relay must always be employed.

A relay for direct mechanical tripping has been constructed at Baden, Switzerland, by Brown, Boveri & Co., for certain cases when the relay is not required to operate with great accuracy and when a very simple arrangement is required for tripping the switch without having to employ a separate tripping circuit. This mechanical relay, which is based on the same principle as the one just described, is so constructed that it trips the switch directly. It also consists of an aluminum disc which rotates between the poles of a laminated iron core carrying a current coil and is also with a short circuited ring. A weight attached to the end of a lever which can be rotated is employed instead of the cord with the weight suspended at the end, and this weight is raised by the spindle of the aluminum disc operating through mechanical reduction gearing. On the weight being lifted a certain height it is released and falls back to its original position, striking the pawl arranged on the tripping mechanism of the switch and enabling the switch to open.

It will be noted that this relay is also a time relay, but the time element cannot be varied as in the case of the one described above, in which the time element is varied by adjusting the length of the cord carrying the weight. This relay is further not so sensitive, as this depends on the condition of the reduction gearing, which consists of two small spur wheels having a certain amount of friction.

A Swiss relay of this form has been mounted direct on a two-pole 8,000-volt switch. The current coil is fed with low tension current from a current transformer, which also at the same time serves for the necessary ampere-meter on the respective switchboard. This arrangement is employed in carbide works when the transformers are subject to very heavy overloads. This relay switches out in 30 seconds with an overload of 50 per cent, or in five seconds when the overload is two and one-half times that of the normal load.

The Brown-Boveri no-voltage and overload relays are used advantageously in connection with large alternate current motors. Owing to a very ingenious combination, the employment of a special tripping circuit has been avoided. A description of same is given below. On the switch there are arranged, as the case may be, viz: single, two or three-phase motors, one, two or three magnet cores respectively, which are held up by means of tension coils, these latter being energized directly from the leads to the motors. As soon as the tension on these leads, owing to some reason or other, disappears, the magnet cores fall and in dropping release a pawl and trip the switch.

It may be stated that in order to also make use of this "No-Voltage" switch as an overload switch, one, two or three-pole overload time limit relays are connected up in the motor circuit, and these relays are so arranged that on the relay operating a circuit is opened and not closed, as in the case of the standard apparatus; that is to say, the circuit of the "No-Voltage"

coil is opened so that this latter again releases the pawl of the tripping mechanism on its particular switch. If the corresponding driving gear of the switch is now combined with that of the starter of its corresponding motors so that the switch after it has switched out can no longer be switched in till the lever of the starter has been brought back to its original position, one obtains a switching arrangement such that the motor is fully protected against an overload which would be too large, or against a wrong manipulation, or also to allow it to remain switched in when the tension disappears.

The reversible current relay is another important device now largely utilized in electric power plants to advantage. The apparatus above described deals with the overload relay which does the work of preventing the machines from giving out or receiving too large a current. This relay ought consequently to be capable of tripping the switch as soon as the current reaches a certain value, no matter whether the direction of the current vector is normal or reversed. One can see from the principles upon which the relay works that it fulfills these conditions. The resulting torque depends solely on the strength of the current and is not affected by the power factor of the circuit. As long as the current keeps within its predetermined limits the particular electric machine which it protects can receive or give out energy without the relay being affected by the direction changed of the flow of energy.

Under certain conditions, however, a reverse current relay may be necessary, as when in an electric generating station in which a number of generators are working in parallel, it might happen that the mechanical regulator of one of the generating sets gets out of order and when the load of the station increases this set may cease to do its share of the work and may entirely fail to supply any energy whatever. The generator may even be driven as a motor receiving current from the other machines. The current as shown by the ampere-meter may under circumstances remain within its normal limits so that no change is observed in the working conditions of the set, although a considerable waste of energy takes place.

Another like condition occurs when two central stations working in parallel the mechanical speed regulators, in the distribution of the load, are not adjusted to work exactly alike so that under conditions of small load it can happen that one plant is driven by the other.

A very common case worth noting is when a synchronous motor which is connected to a long-distance transmission line works in conjunction with mechanical prime movers or with electric motors driven from an independent source. Should a fault now occur in the central station or an earth on some portion of the transmission line, so that the supply of energy is cut off from the sychronous motor, the motor would now be driven as a generator and would supply electric energy back to the line.

It is therefore held with truth that the overload relay, as well as fuses, under certain circumstances do not meet with all the requirements of the service and the new reverse current relay becomes of great value.

It will be noted that the reverse current relay operates when the flow of energy is reversed, that is to say, the current and tension influence the apparatus. The general arrangement of the reverse current relay is very similar to that of the overload relay, except that the former is provided with two electro-magnets; one tension and one current coil per pole. Short-circuiting rings are no longer necessary, as the two magnets help to form the rotating field. The field produced by the current coil is approximately in phase with the working current of the line, that produced by the tension coil lagging approximately 90 deg. behind the tension. A time limit tripping device is not necessary in a reverse current relay. The aluminum disc is held in check by means of a weight attached to the end of a silk cord, which latter passes over a small drum.

As long as the flow of energy is in the right direction the aluminum disc is prevented from closing the tripping solenoid circuit by means of a catch, but on the direction of the flow of energy being reversed and on the energy rising above a certain figure, the disc makes a complete revolution and closes the circuit of the continuous current tripping solenoid on the switch.

In monophase and diphase plants single and two-pole reverse current relays are utilized and in polyphase installations a two-pole relay with two single-phase tension transformers is made use of, if the two-wattmeter method of connecting up is employed in connection with reverse current relays.

It is claimed that the reverse current relay can also be used in conjunction with an overload relay by making use of the same current transformers. In this case the current coils of the overload and reverse current relays are connected in series with the secondary side of the current transformer.

It is stated that in many instances these relays are mounted on existing switchboards, as in nearly all large plants in England, although the switches, of course, have to be provided with tripping coils for the automatic releasing.

COPPER MARKET SITUATION.

The trade has again witnessed a farther advance in market prices for copper during the past thirty days, and consumers are now confronted with conditions that seem to indicate a continuance of the same undertone of strength which has been the recent feature for all kinds of copper. Important new engagements have been entered into by consumers for shipments in April, May and June, and purchases for those months have consequently relieved sellers of a good share of the output between now and next July. Quotations are now on the basis of 26@26½ for Electrolytic Wire Bars for late future deliveries, and 26@26½ for prime Lake brands. Prices on recent contracts have been somewhat diversified, and buyers have been forced to pay premiums for prompt deliveries, while the distant futures are procurable for a little less than spot copper.

Conditions in the copper and brass manufacturing industries are good, but the operations of these interests could be carried on in a more satisfactory manner, in some cases at least, if it were always possible to obtain plenty of raw material for the three months immediately ahead. Consumers are not particularly concerned about the price of copper, but that which chiefly interferes with the conduct of their business along normal lines is the inability to get copper in sufficient quantity for delivery within 60 to 90 days, so that the entire machinery of their establishments may be kept continuously going at full capacity.

To secure full supplies it is necessary to contract for them four or five months in advance, and in our judgment this course becomes too great a speculative proposition, with values at the present level, to harmonize with the principles of a sound, conservative business policy. Whether copper costs the manufacturer 25 or 30 cents a pound is a question of secondary consideration. The essential thing for the consumer is the ability to secure metal in the quantities wanted and at the time wanted. There exists a good demand for copper at present, and when this is the case it can be turned into a manufactured state, delivered and paid for in a reasonable time. But to assume obligations and enter orders of an enormous aggregate, and then have to wait from four to six months before a fulfillment of these can be accomplished, this is an ordeal of too exacting a nature for legitimate manufacturers to assume without placing a heavy premium upon their capacity for business acumen. The strain upon credit inseparately connected with the process is in danger of becoming too intense for the preservation of a healthy tone in the situation. When credits and purchases are kept within reasonable periods the risks of business are thereby maintained at a limited scale, but when obligations and contracts are allowed to become unduly extended there is the liability to overstep the safety line. Our plea is for those principles and methods that will best conserve the interests of all concerned, and which will tend to promote progress and develop the expansion, on thoroughly safe lines, of the varied interests identified with copper.—*From Copper Gossip.*

WHAT KIND OF TECHNICAL TRAINING IS BEST FITTED TO ATTAIN THE SERVICE IDEAL?*

We will assume the service before our minds is that which is needed in an industrial community engaged in production. This latter I will define as the process of increasing wealth resulting from spending labor upon a raw material or a product of the soil. I think an older ideal that education should be so directed as to fit every boy to rise to be President of the United States in one which has worked harm upon our practical thinking. It is manifestly impossible within seventy years of a man's natural life that more than a very small number of the many millions of our population should ever reach this eminence. What of the many debarred from this possibility, but who must yet be wage earners?

In the forwarding of modern economic production it seems to me there is a demand for three kinds of ability. The education in the community should be directed to discipline and knowledge in each field of service. This recognizes the generally received analysis that under the board of directors of a manufacturing corporation will be the three departments, which may be designated as the works or productive department, the office or accounting department, and the sales department. In developing this analysis, it will be plain that the largest group numerically will always be the artisan or craftsman class, who work with their hands upon the raw material, either directly or through the media of tools. These tools they do not or have not designed, but they operate them and make them go. These are the workers at their respective trades; they enter them as bread-winners or producers after their childhood's contact with the public school, and either after their contact with such schools has become completed, or before. For this great group it seems to me that the call is the loudest that proper provision be made that they should be specifically fitted for usefulness by the education which they receive before going to work, or which they may receive during its continuance. Their numerical importance makes industrial education for such persons a splendid opportunity for those who are gifted with vision and with wealth to render their service in this form. This education need not be deep nor decorative, but it should be broad and practical. It should be so directed that it may be an inspiration for the daily toil required of those who must be wage-earners as a means of personal or family support, and who must be economically productive from boyhood. It should cover the scientific and natural laws behind the material things which they handle or control. It should reveal the intellectual and philosophic basis of their life, making it not unworthy of the divine element in man. It must make him more than a mere high-class automatic machine. It must show the man that he is greater than his work and that this latter is a means and not an end. It must show him that possibilities of growth and achievement are his personal right, even while he appears to be contributing only as a unit in the productive process. All honor to wealth and to achievement, which have seen and shall see this opportunity of service to the craftsman and shall move forward to meet the demands for industrial education among the wage earners.

A second class will be the organizers and directors of the craftsman, who, together with their machinery and plant, form the producing apparatus which we call a factory or mill or works. In this group will be the general managers, the draftsmen, the engineers, the superintendents and the industrial organizers. To this class belong the product turned out by the engineering schools. The young engineer in either the mechanical or electrical specialization of the day is likely to be a manufacturing engineer. They must necessarily constitute a smaller class than the preceding, but from their duties and function they will be the best paid. They are the most vitally essential under modern competitive conditions, where conformity to physical law is imperatively demanded if success is to be won without its costing too much. For these men knowledge of the crafts which they are to control is essential, but even more so a knowledge of science and its laws, covering familiarity with accepted solutions for old problems and the trend of research into new ones. For such men beside the class-room, the laboratory, the drawing-room and the school-shop, will form the desired equipment. All honor to Clarkson and to other institutions of like grade and character who are seeking to satisfy this call. The usefulness of such institutions is deep and is far reaching because profound. It is not so broad nor so far reaching in the other sense because the numbers affected are less.

The third type of service is rendered in the office and in the commercial functions of the producing process. Such service is rather what is technically designed as "personal" service rendered to the producer class rather than a direct contribution to community wealth. The compensation of such persons is a draft upon the producing cost, and hence they ought not to be too numerous. They help the easy conduct of the production process and will be fitted for their work, both by special commercial training such as is offered in business colleges and correspondence schools, and by such general education as shall give them broad views, a wide range of adaptability and a capacity for suggestive recommendation in their appropriate field. The tendency, however, of modern intensive production is to reduce this class to its lowest terms.

I put, therefore, the education of the craftsman group as the first or prime need of a service education because affecting the greatest number of the producing class. I put the education of the selected group of designers, works managers and directors of production as second only to this opportunity by reason of the less numbers affected, and not by reason of any misapprehension of the importance of having the duty of these men well done.

How May You Personally Attain this Ideal of Service?

The final stage of my argument must seek to make the theory of the foregoing apply as a personal matter to each one of us in his practical affairs if it is sound. For there is no such thing as rendering a real service if it is of no use to any one. How can we be made useful by reason of our training; or how can technical education make us useful?

I shall be satisfied if I can fasten two practical answers. We will, of course, be made useful and render service almost in our own despite, if we engage in economic production and apply our talents and knowledge and skill to this end. But higher than this and as a means of making the best of ourselves, I would specially urge that each should so labor that every study and every problem and every law is made a compulsion that we should think.

I have condemned already the mechanical-recipe system of working out solutions by rule, and without much thought. This may be used to make a well-informed man, but it will not make an educated one. The two terms, "educated" and "well informed," are not synonymous. I demand that the process of education should be so directed and planned the powers of the student's own mind shall be awakened, stimulated and compelled to exert themselves. The mechanical laboratory is particularly well adapted to secure this result, because, from the practical and material apparatus before the student's eye and under his hand, he can be forced to consider the connection between his mental concepts and the actual occurrence before his senses. He should be compelled, first, to think clearly and definitely and to enunciate what the experiment is aimed to show. He should then create or assemble apparatus suitable and necessary to answer his inquiry or to prove his assertion. He should then so arrange the apparatus as to make it truthful and accurate in its reports, and give his reasons why or to what extent it is thus reliable. He should then record and finally discuss his observations upon the forces and laws at work before him.

*An abstract of an address by Frederick Remsen Hutton, E.M., Ph.D., at the Charter Day address at the Thomas S. Clarkson Memorial School of Technology.

While it is a manifest labor-saving process to furnish the laboratory student with printed log blanks, having headings previously worked out over the columns which are to be filled with his observations, I consider that such labor is saved at an educational expense of a greater equivalent. The man may complete more experiments by the log-blank method; ;but by the other system the experiments, which he had made under it, are parts of his mental, as well as his bodily experience. They have, furthermore, compelled a mental activity which is a calisthenic exercise in itself, and which leaves him a different man and a better one than he was before. I have condemned already the danger of smooth and facile lectures taken by a free election and without reference to the student's own needs. Education should teach a man the meaning of a task as a thing to be done, whether he likes it or not, and should also teach him to use his mind upon his task.

The other thing which I would urge is that the subject-matter or content of the experimental study to be used as discipline, be chosen from among the play of laws and forces, which concern the common and usual experiences of an industrial life. The purpose of this recommendation is to minimize the difference in atmosphere and condition at the educational center from that which is sure to prevail in actual life. There must be a difference, since the unit or standard of measurement in real life is the dollar, while that most suitable for the educational institution should be one which is not a variable with expediency as its exponent. In working under Nature's laws in practical affairs it is as true for us as for the old writer that all things in accordance with such laws are lawful for us, but all things are not expedient. At the school the learner must have it brought home to him, and clinched, that Nature cannot be lied to nor deceived. She insists upon truth in the inward parts, and must be obeyed, no matter what it costs. The training in what is practically economically possible under Nature's laws and what is, therefore, expedient, must be the function of life itself after leaving the school, and the best of us can only hint at such matters in the educational process. Within the limitations, however, which are set by the conditions, let the learner get in as close touch as possible with the facts and phenomena of the world of practical affairs. The technically-educated man has this great advantage over his academically-trained associate—that for the latter the classic languages, the civilization of dead nations and their history, refinements of pyschology and even some forms of literature and antiquarian research are without immediate relation to the functions which the man is to discharge when he becomes a worker. Never have I seen this more tersely put than in the epigram of Prof. John E. Sweet, of Syracuse, when he compared the usefulness of him who knew "what to do and how to do it," with that of another "who only knew what had been done and who did it."

THE DEADLY ELECTRIC WIRE AND THE CONDITIONS UNDER WHICH IT IS MORE OR LESS DANGEROUS.

The danger incurred in touching an electric circuit does not depend wholly on the voltage or electric tension. Two-thousand-volt circuits have been touched with impunity, and contact with incandescent-light circuits of only one hundred and twenty volts has caused instant death.

The physiological effects of electricity are due partly to electrolysis or decomposition of the blood and other fluids and partly to paralysis of vital organs. Both actions are proportional to the strength of the current that actually passes through the body, and this current strength is equal to the voltage of the circuit touched divided by the electric resistance of the body. The average resistance measured between a hand and the feet, when the hand is moist and the shoes are soaked with water, is about 5,000 ohms. A current of one-twentieth of an ampere—one-tenth of the current used in an incandescent lamp—may cause death. Hence, the question is, Under what conditions will contact with an electric wire send such a current through the body?

If the right hand touches one wire and the left hand simultaneously touches the other wire of a 110-volt incandescent lighting circuit, the body, assuming its resistance to be 5,000 ohms, will be traversed by a current of 110-5,000 ampere, or little more than one-fiftieth of an ampere, which is within the limit of safety. But if the hands are dry the resistance measured from hand to hand is fully 10,000 ohms, so that both wires of even a 220-volt circuit, such as is used in some incandescent lighting systems, can be touched without danger of serious injury. In certain factories, however, where the air is damp, warm and laden with acid vapors, the skin becomes softened and the resistance so greatly diminished that it is not safe to touch both wires of even a 100-volt circuit.

The writer's left hand once came so near the terminals of a 1,000-volt transformer that it drew luminous electric arcs from them. The current, having so small a resistance—less than two inches of the hand—to overcome, was very strong, but it caused no injury except local burns, because it did not traverse a vital part. In instructive contrast to this case is the experience of the inventor of an electric bath tub containing metal plates that could be connected with a 220-volt lighting circuit. The inventor tested the device on himself and was instantly killed because soaking in water had so reduced the resistance of his body that even this low voltage produced a deadly current.

If a man, standing on a trolley rail or even on the ground, touches a broken trolley wire carrying the usual pressure of about 500 volts, a current of one-tenth of an ampere will pass through his body, if its resistance is 5,000 ohms, and will probably cause death. In this case the ground or the rail represents the second or return wire. It is much less dangerous to touch a single wire of a double-wire circuit, well insulated from the ground, for in order to reach the other wire the current that traverses the body must flow through or over some of the insulators, that is to say, through a very great resistance, so that the current is very weak. But in a very long line the sum of these little leakage currents through many insulators may be too great for a human body to carry with safety. Hence, the danger is proportional to the length of the line. Simultaneous contact with both wires of a high-voltage circuit is, of course, fatal.

The static electric charge of the wire, as distinguished from the flowing current, is another source of danger, at least in alternating circuits. In continuous-current circuits this charge acts only once, at the first instance of contact, but in alternating-current circuits the charge is changed from positive to negative and back to positive usually about one hundred times a second, and when a man touches the wire the electricity which forms these charges surges back and forth through his body. Most of the casualties produced by touching alternating circuits are due to this cause. The danger is proportional to the electric "capacity," and therefore to the length of the wire. Burying the wires increases their capacity and makes them still more dangerous to handle, but it effectually keeps the average citizen away from them.

The danger is proportional to the frequency of alternation, if the frequency is not very great, but currents of several hundred thousand alternations per second, such as Tesla employed in his amazing experiments, do not penetrate deeply, so that when they traverse the human body their effects are confined to the skin and are not serious. The facts that high voltages and high frequencies have been commonly associated in experiments and that extremely high frequencies have been shown to be harmless, have led to the wide-spread belief that exceedingly high voltages are quite free from danger. This is entirely erroneous, as the curious reader may easily prove to his own satisfaction—or, at least, that of his heirs.—Condensed from Herman Zipp, in "Die Umbschau," and reprinted from the "Scientific American."

PILE PROTECTION.

By Coleman Meriwether, M. Am. Soc. C. E.*

The protection of wooden piles in salt water against the attack of the teredo, limoria and other marine wood borers, is a question to which engineers throughout the world have given a great deal of thought and study.

The teredo is found on the entire coasts of the United States, Mexico, South America, Africa, Australia and portions of Europe and Asia, and is most active in the United States, along the Mexican Gulf and the Pacific Coast.

The writer has made a careful study of the ravages of this mollusk, and finds that it works differently and with a different degree of rapidity in almost every locality.

The teredo only attacks a pile for the entire distance between the mudline or bottom and mean high water, but in fresh water flowing into salt water bays, the teredo almost invariably confines its attack to the bottom of the pile entirely. This is a most dangerous condition, as a pile inspected at the surface of the water may appear perfectly sound when it is eaten away at the bottom. This condition is easily explained by the fact that the rivers referred to contain both fresh and salt water. The fresh water being lighter comes to the top; the salt water being heavier goes to the bottom, and as the teredo only works in salt water, it confines its operation to the bottom portion of the pile entirely; the conditions referred to above.

Numerous modes of protection have been used, and the one which is most generally used is probably creosote. Creosoted piles withstand the attack of the teredo in some localities almost indefinitely; in other localities its succumbs to the attack in a very short time.

Mr. Alex. Stewart, assistant chief engineer of the Great Northern Railway, told the writer that he has known of cases where creosoted piles in the Puget Sound have been rendered useless in eighteen months.

Mr. D. Lombilo Clark, director general, public works of the Republic of Cuba, informed the writer that the average life of a creosoted pile in Cuban waters is from three to four years. He stated that the large government wharf at Matanzas, which was completed about four years ago, and built on creosoted piles, is badly eaten.

The writer is at present engaged in protecting piles at Pensacola, Florida, which were treated with twenty pounds of creosote per cubic foot, and have been in the water eight years. These piles are now being covered with a concrete pipe.

Sheathing the piles with copper is a common mode of protection in Central and South American countries and on the Pacific Coast. The present price of copper makes this method of protection almost prohibitive. Piles sheathed with copper withstand the attack of the teredo to a great extent.

Mr. Percy Evans, of Evans, Coleman & Evans, Vancouver, B. C., stated to the writer that they have a large wharf built on piles which are covered with copper. For some reason, which he is unable to explain, the copper sheathing deteriorates and comes off for a few inches above the mudline and renders it necessary to repair piles in this wharf with the aid of a diver, who replaces the old copper sheets with new ones.

The Louisville & Nashville Railroad Company have gone very deeply into the matter of pile protection, and Mr. R. Montfort, consulting engineer of that company, who was previously chief engineer, read a paper before the American Society of Civil Engineers some time ago, describing various modes of protection in use on their lines, stating that he thought the best mode of protection that they had used was vitrified clay sewer pipe strung over the tops of the piles. The bell and spigot ends were sealed with melted pitch, and the annular space between the pipe and the pile was filled with sand after the pipe had been placed on the pile. This method of protection has proven very effective, and has been in use on the Louisville & Nashville Railroad Company for fourteen or fifteen years; the only objection to this form of protection being that it had to be placed on new structures before the piles were capped, which delayed the carpenter forces, and if it were desired to protect an old structure, the caps had to be removed in order to place the pipe, which made the operation very expensive.

The Florida East Coast Railway used, in the past, almost exclusively, for pile protection, vitrified clay pipe, which was made in halves, having an ordinary butt joint, which were placed around the pile and wired together. The space between the pipe and the pile, in this instance, was then filled with concrete, as it was impossible to fill it with sand, owing to the fact that the butt joint could not be made tight enough to hold sand.

Mr. E. Ben Carter, engineer and general roadmaster of the Florida East Coast Railway, has stated to the writer that they have abandoned this mode of protection for three reasons; one being that the concrete caused the pipe to adhere to the pile and would not allow the pipe to settle with any scour which might occur at the mudline or bottom, and, therefore, if the scour did occur, the pile would be left unprotected at the bottom; another objection being that in placing the concrete in the pipe in deep water the ingredients of the concrete became separated in passing through the water, and that the lower pipe or two would become filled with sand instead of concrete, as the sand being heavier than the cement, would reach the bottom first. Then the sand would be washed out through the butt joint and leave two or three feet of the pile unprotected at the bottom. The writer has seen piles protected in this manner which have been entirely eaten away at the mudline. Another serious objection to this form of protection is the difficulty of inspecting it.

After carefully considering all the difficulties encountered by various modes of protection, the writer believing that pipe filled with sand affords the best protection, organized a company to manufacture a concrete pipe divided into halves, which could be placed around the piling, then filled with sand, using for this purpose a scarf lock joint, which could be sealed absolutely tight, and a joint which would hold the finest sand.

The pile trestle of the Seaboard Air Line Railway across the Manatee River Bridge at Manatee, Florida, was protected by this method about a year ago, and an inspection made in January of this year showed that on the entire structure the pipe was intact and filled with sand from top to bottom, only one section of pipe being broken; this having a round hole in it caused by a blow just above low-water line.

The method of protecting piles by the concrete pipe referred to is easily placed on structures which are in use without interfering in any way with the use of the structure or traffic over it, and can likewise be easily repaired in the same manner, by removing the broken section of the pipe and allowing all pipe above that to slip down to take the place of the broken section, and place a new section at the top.

From best information which could be gathered by the writer, the costs of various protections are as follows:

Creosote, 35 to 50 cents per lineal foot for the entire length of the pile.

Ordinary sewer pipe filled with sand, placed over the tops of piles, $1.25 to $1.35 per lineal foot for that portion of the pile which is in the water.

Sewer pipe and concrete, $1.35 per lineal foot for that portion of the pile which is in the water.

Concrete casings placed in forms, $1.15 to $1.50 per lineal foot for that portion of the pile which is in the water, according to the depth of the water.

Lock-joint cement pipe, $1.00 to $1.15 per lineal foot, placed around the pile and filled with sand, for that portion of the pile which is in the water.

*President of the Lock Joint Pipe Co., 346 Broadway, New York City.

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EDITORIAL.

Liquid and Gas Fuel Prime Movers

The invention and perfection of the steam engine was probably the most important advance in engineering resulting from the design and construction of a single piece of machinery. As a means of converting heat energy into mechanical energy the steam engine has up to the present time been more extensively used than all other heat motors taken together. Within recent years, however, the advances made in the introduction of the explosive mixture motor have been of great importance and particularly in small units for automobiles, launches, and even in comparatively large sizes for individual motor cars on either branch or main lines of existing steam railway systems. For stationary service, gas engines of very large size have been built and have in general given very satisfactory service in every case when the gas used has been made with especial reference to its consumption for the generation of power.

Commander A. B. Willits of the U. S. Navy has recently contributed an article to the Journal of the American Society of Naval Engineers, in which the probable future of the internal combustion motor as a substitute for the steam engine on shipboard is carefully considered, and his conclusions are worthy of the attention of engineers in general.

With liquid fuel he states that the following objectionable features, necessarily present with steam installations on board ship, are eliminated, namely:

No boilers,
No pipe lines under pressure,
No smoke,
No ashes,
No coaling-ship distresses,
No stoking furnaces,
No condensers to keep tight,
No forced-draft blowers,
No fuel cost or delay in getting up steam,
No fuel cost by keeping fires for "standing by."

Two other advantages given are that all mechanical operations in different parts of the ship will probably be accomplished by electrical apparatus worked by a supply current from a central plant operated by independent "gas" engines, and that the weight of the machinery for propelling the ship will be enormously reduced.

Considering the construction and operation of the motor itself, it is said there are no real difficulties at present unconquered, and therefore the ultimate extensive use of this type of prime mover as a source of power for sea-going craft depends merely upon the question of securing an economical fuel, readily obtainable at the principal ports of the world. Gasoline is an ideal fuel for the practical operation and retention of light construction in this class of machinery, while an alcohol-gasoline mixture and kerosene closely follow. It is possible to safely carry gasoline on shipboard, providing the construction of all tanks and fittings is such as to prevent accidents which can only occur from what are now well known danger conditions.

The cost of the liquid fuel, however, is a serious disadvantage. Comparing the cost of an indicated horsepower using coal at $3.00 per ton and gasoline at 15½ cents per gallon, we find that the cost per individual horsepower using coal will be less than ½ cent, while with gasoline the cost is slightly less than 2 cents, the above figures being determined under average and usual conditions. While the fuel for the internal combustion engines will probably cost nearly four times as much per unit of power as when steam engines and boilers with coal as fuel are used, nevertheless the savings due to a decreased engineer's force, decrease of fuel, expenditure for "stand-by" purposes, decrease in cost of repair and up-keep (in which retubing of boilers about every three years is a tremendously large item), and decrease in interest on cost of plant are, taken together, of such importance that the annual cost for a gasoline-motor torpedo boat will not exceed that of the steam driven vessel of the same type and power.

While for stationary use the conditions are vastly different than on vessels of the torpedo boat class, yet if the engineers of the navy are giving the liquid fuel internal combustion engine such careful consideration and believe in its availability and reliability under such

exacting conditions as always exist on naval vessels, it is certainly time for this type of prime mover to be fully tried as a source of power in stationary plants, especially since with the prospective decrease in the cost of alcohol, it may be possible to reduce the fuel cost by using a most efficient mixture of alcohol and gasoline, although it may be several years before denatured alcohol can be secured as low as 10 cents a gallon.

BOOK REVIEW.

The United States Geological Survey has issued its Report on the Mineral Resources of the United States for the calendar year 1905. An exhaustive report on the "Black Sands of the Pacific Coast" is included.

TRADE CATALOGUE.

The Holtzer-Cabot Electric Co.: This Company has just sent out to the trade several little leaflets descriptive of the following specialties:

The "H-C." Indicator or two-spot annunciator.

The "H.-C." combination return call bell and button.

Type "A" flush telephone.

A new water tight bell.

Allis-Chalmers Company: Allis-Chalmers steel ventilating fans is the subject of Bulletin No. 1418. Although dated September, 1906, this has never been distributed. It is filled with valuable information on the subject of ventilating mines, foundries, rolling mills, etc.

The Automatic Refrigerating Co. of Hartford, Conn., have issued a little catalogue regarding complete refrigerating installations of capacity suitable for small plants. The system shown is automatic throughout, doing away entirely with any attendance, and the matter of economy of operation is well shown.

ANNOUNCEMENT.

Allis-Chalmers Co. announce the establishment of a new branch office in New Orleans, located at 316 Godchaux Building, where their representatives will welcome all who are interested in any of the machinery which they manufacture.

SEATTLE MEETING OF THE AMERICAN SOCIETY OF ELECTRICAL ENGINEERS.

At a recent meeting of the Seattle Branch of the American Institute of Electrical Engineers, a letter from Secretary Pope, of the National Organization, in reply to the question of holding the National Annual Convention in Seattle during the A. Y. P. Exposition, was discussed.

Secretary Pope thought it unwise to do so as the experience in the past has shown that the sessions, when held at expositions, were not well attended, nor were as profitable as when held in a more central location, and at a time when no other attraction was going on.

His suggestion, however, that the Seattle Branch invite all engineers west of the Rocky Mountains to attend a convention, will be acted upon by the members.

For the April meeting the "Telegraphones" will be explained and exhibited by Mr. O'Reilly, and W. S. Hoskins will speak of "Electrolytic Corrosion of Iron and Steel in Concrete."

The May meeting will be devoted to a discussion of the "Hawley Pumping Plant," by Messrs. Moore and Simpson.

In June the society will make its annual trip, this year to Eastern Washington to inspect the Spokane & Inland Railroad.

Henry R. Stevens, an engineer in the office of Archibald Downie, CE., Seattle, was admitted to membership.

THE SUITABILITY OF CONCRETE AS A MATERIAL FOR BUILDING FORTS AND BATTERIES.

The Russian-Japanese war demonstrated the suitability of concrete as a structural material for building forts and batteries, according to the report of Major Joseph E. Kuhn, Corps of Engineers, U. S. A., an extract of which is presented:

The Russians employed concrete almost exclusively for the masonry work of their forts and batteries. It was largely made of rounded pebbles and much of it was of indifferent quality, far inferior to what would be acceptable in the United States. The cement employed was of a Portland Russian manufacture, and there is no reason to suppose that it would not make a good concrete. Where damaged by artillery fire the concrete was frequently observed to be porous and friable, as if insufficiently compacted. Much of it was also shelly and seamy, no pains having been taken to secure a monolithic structure. No doubt the poor quality of the concrete was largely due to the employment of unskilled Chinese labor which was used in the construction of the defenses.

Notwithstanding the indifferent quality of the concrete, it appears to have answered the purpose well when subjected to bombardment. Shells striking corners or edges naturally chipped out chunks of masonry, but there was not a single instance of a magazine or chamber penetrated along the entire front. There was no evidence of the Russians having employed armored or reinforced concrete in any of their works.

So far as the results at Port Arthur go, concrete will continue to be a most useful material in building forts and bateries, combining, as it does, economy and good resisting qualities.

POWER PLANT FOR JAPAN.

An enterprise involving the investment of millions of American money in Japanese manufacturing and power plants and providing for the construction of an electric plant in Japan with a capacity of 70,000 horsepower, is being perfected by W. E. Guerin, of New York. Mr. Guerin is best known as one of the builders of the Palmer cut-off, now a part of the main line of the Northern Pacific, under the corporate name of the Seattle & San Francisco Railway and Navigation Company.

The purpose of the project is to develop the water power from a mountain lake near Kyoto which is an import city close to Osaka. Both cities are great cotton manufacturing centers. Osaka is an important port as well.

The lake lies at a great elevation above the sea. The plan is to bring the water by means of a tunnel through a mountain, down to a level several hundred feet beneath the lake. The water will be dropped into great concrete penstocks and turned on to turbine-power generating wheels. Power sufficient to operate a great many cotton mills and for electric railroads and light plants for the surrounding cities will be generated.—"Pacific Builder & Engineer."

Bakersfield, Cal.—Another large deal has been consummated by the Monarch Oil Co., controlled by the Spreckels interests in San Francisco, by which the company becomes owner of the entire holdings of the Occidental Oil Co. in the Sunset and Midway oil fields. The Monarch Company is about to commence the construction of the largest oil refineries in the State on the property just acquired. It will be located on the railroad, and work on it is to begin at an early date. Plans and specifications have been drawn, and it is said that capacity of the refinery will be greater than that of any similar plant in California.

REPORT OF SPECIAL COMMITTEE ON ELECTROLYSIS.

Being a Part of the General Report on this Subject to the American Gas Light Association.

The American Water Works Association unanimously adopted, in 1901, the following Report of Special Committee on Electrolysis:

"Your Special Committee on Electrolysis, appointed to make recommendations for the guidance of the Association in dealing with the problem, and to formulate, for your approval, an expression of the attitude of the Association on this question, respectfully begs to submit herewith its report. The following facts are established:

"1. A very large number of mains and service pipes have been already actually destroyed by the stray return currents of electric railways operating under the single-trolley system, many instances of such destruction of pipes by these currents having been reported from practically every city where the single-trolley system has been in use for any considerable length of time. Even where the action is too slow to be immediately discovered, the life of the mains and service pipes is inevitably greatly shortened and their value thereby necessarily proportionately decreased.

"2. In the single-trolley system, no matter how large the capacity of the return feeders, nor how good the bonding of the rails, and even when the continuous rail is used, some electric current will, under the law of divided circuits, flow along the water pipes, the amount of this current bearing the same proportion to the total current used, that the conductivity of the return path of which the water pipes form a part bears to the total conductivity of all the return paths offered to the current. As neither the rails nor the pipes can practically be insulated from the soil in which they are laid, the proportion of current conveyed by the pipes is considerable, even with the best track bondage known to modern science, including the welded joint.

"3. The electric current, once on the pipes, must leave them to return to its source, the generator, and wherever the current leaves the pipes to pass through the soil, the pipes are damaged.

"4. Electrolysis also results from differences in potential between water pipes and any other underground metal conductor, such as gas pipes, and as long as the return current is not entirely removed from the earth, such action will continue.

"5. The extent of the electrolytic injury at any point is directly proportionate to the number of amperes of current leaving the pipe. The smallest measurable difference of potential is sufficient to produce electrolysis.

"6. A cast-iron water main is not a continuous electric conductor, and its joints offer very much higher resistance than an equal length of the plain pipe.

"7. The inevitable effect of any resistance at the joints is to cause a part of the current carried on the pipes to be shunted around the joint, either through the soil on the outside or through the water on the inside, or by both paths.

"8. Wherever the current leaves the pipe to pass around the joint, either outside or inside, or both, the pipe is injured. The action of a fraction of an ampere flowing around successive joints will in time do great aggregate damage to any cast-iron main on which it flows.

"Your committee is convinced, after careful consideration of reliable data on the subject, that there is no known practical method by which owners of underground pipes can protect them against electrolytic injury from single-trolley currents, but that there are two methods of operating electric railways by which the return currents can be kept out of the ground; namely, the conduit system, as in use in New York City and in Washington, D. C., and the double, overhead trolley system, operated in Cincinnati, O., and on suburban lines in the District of Columbia.

"The conduit system is more expensive to construct, and is peculiarly adapted to the larger cities. The first cost of installing a double-trolley system would be a little greater than that of a single-trolley system for the same service; while the cost of converting an existing single-trolley system to a double-trolley system would be trifling, as compared with the enormous interests endangered by the single-trolley current.

"Ten years' experience with the double-trolley in Cincinnati proves that that system is entirely practical, possesses many advantages over the single-trolley, is more economical in operation and maintenance, and that it completely stops the injury to the pipes.

"Your committee, therefore, respectfully makes the following recommendations:

"1. Street railway companies should be compelled, as are electric light companies, and all other electric power companies, to provide a complete metallic circuit for their current, absolutely insulated from the rails and ground. This will keep the return currents out of the ground and off the pipes, and can be accomplished either by the conduit system or by the double, overhead trolley system.

"2. No connections by which a current is carried to the pipe, or induced to flow thereon, should be allowed from pipes to rails, or to other return conductors; and no other alleged remedy which permits the mains to carry any portion of the return current should be countenanced by those in charge of waterworks plants. Even the failure to prohibit or to protest against such connections might be construed by law to be a tacit consent on the part of the waterworks management to use the pipes as conductors, and might relieve the electric railway company from responsibility for the injury which would inevitably result if the mains were allowed to convey current."

New York Copper Prices.

The following were the quotations for copper futures in the regular market on the dates given:

1907	Lake Cents per lb.	Electrolytic Cents per lb.
Feb. 15	25½	25 @25¼
Feb. 21	25½	25 @25¼
Mar. 1	25½@26	25 @25¼
Mar. 8	26 @26½	25¼@25½
Mar. 15	26 @26½	26 @26¼

Comparison with prices last year:

1906	Lake Cents per lb	Electrolytic Cents per lb.
Feb. 15	18½@18¾	18 @18½
Feb. 21	18½@18¾	18½
Mar. 1	18½@18¾	18¼@18½
Mar. 8	18¾	18½
Mar. 15	18¾	18½

The most important recent business was the sale of some millions of pounds of copper by the Calumet & Hecla Company at the tip-top prices of 26½ for April and 26 for May and June deliveries. It was something of a surprise to the trade that the sellers of this particular brand should decide to put two different prices on the copper disposed of in the business alluded to, and the fact was regarded as a determination of the parties of the first part to lead manufacturers to properly appreciate the luxury of a fancy article. Since these transactions the entire market has hardened, and other brands have advanced from ¼ to ½ cent per pound.

INDUSTRIAL

NEW TYPES OF PORTABLE AND STATIONARY AIR COMPRESSORS.

The rapidly increasing applications of compressed air in industrial manufacturing plants in private institutions, power plants and car barns has given quite an impetus to the manufacture of electrically driven air compressors which are self-contained and conveniently taken to the place where the compressed air is utilized.

The number of applications which can be made of air power are too numerous to permit of enumeration, but it suffices to say that in all industrial operations such as drilling, riveting and chipping work on metals, compressed air tools can be more advantageously employed than purely manual or mechanical operated devices. In car barns of electric railway companies or at the terminal houses of steam railways compressed air is highly convenient and effectual as a means of thoroughly freeing armature coils and all parts of the electrical apparatus and car from dirt and dust. In power houses and sub-stations compressed air offers many advantages in the way of convenience, adaptability and thoroughness as a medium for blowing out dust from generator coils, field magnets and commutators. In automobile garages the use of compressed air is especially advantageous as the most convenient, quickest and easiest method of inflating tires, cleaning dust from every nook and cranny of cushions, upholstered seats, running gear, etc. The extreme simplicity, flexibility, cleanliness and reliability of air as a source of power cannot be surpassed and is coming to be better recognized.

To satisfy the demand for a compact, self-contained and stoutly constructed portable compressor outfit, the National Brake and Electric Company has designed and manufactured a type which will appeal to purchasers desiring a convenient and durable appliance at a minimum cost, consistent with high-grade apparatus.

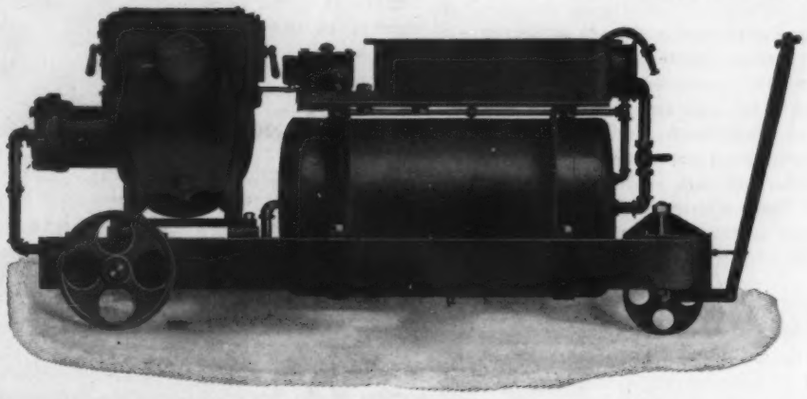

Fig. 1. National Portable Compressor Outfit

The outfit comprises a compressor, an automatic type "N" governor and necessary piping, an air gauge and reservoirs, and a combined switch and fuse, the whole being mounted on a substantial angle iron frame supported on wheels. The front wheel is hung in a pivoted fork made of cast steel, the outfit being drawn around by means of a wrought iron tongue.

One of the greatest advantages in the design of National portable air compressors is the exceptionally small width of the outfit which is gained by such a disposition of the parts that there is no waste of space on the truck. The width of the outfit over all is but 29¾ inches, which readily permits it to be taken through doors and openings in shops and factories of much smaller size than the average. In crowded mills and factories the National portable air-compressor outfits may be easily taken through spaces where other types of such apparatus would be wholly impracticable.

The Air Compressor.

The air compressor furnished with the portable outfit is the National Standard New and Improved, in which one of the many distinctive features is the construction of motor and compressor as entirely separate and self-contained units. When the two parts are assembled a most compact and rigid compressor unit is produced. The crank chamber cover and the motor base are separated by a half-inch air space, which acts as an insulator of the heat radiated by the compressor. Thus the motor is always cool in operation. This separate cover gives the required bracing and stiffening for the crank chamber casting.

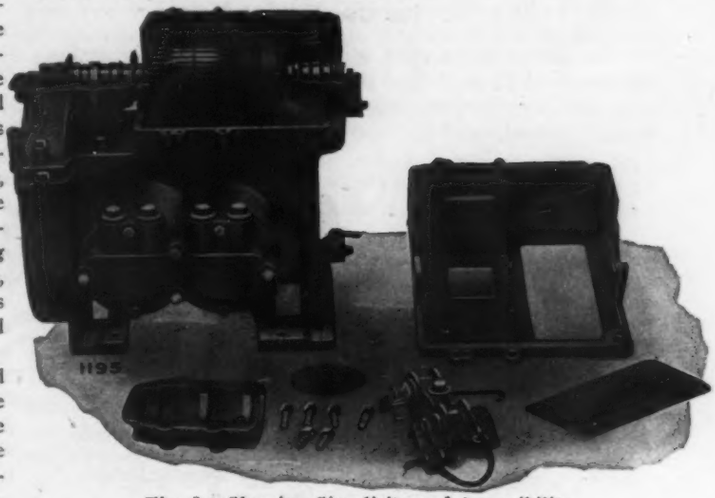

Fig. 2. Showing Simplicity and Accessibility

The simplicity of design and construction, as well as the accessibility of all parts likely to need attention are illustrated in Figure 2. The crank shaft is fitted with a third bearing in the center, which, in addition to supporting and strengthening it at its weakest point, eliminates all tendency of the shaft to fracture at the center.

All bearing and working parts of the compressor are very thoroughly and effectively lubricated by means of the standard splash system of oiling. The gear and crank are enclosed in a bath of oil which is splashed over all the operating parts of the compressor.

The valve head is constructed with the discharge valve toward the center and the suction valve toward the outside of the head. The discharge pipe runs straight out from the valve head

to the main reservoir, thus dispensing with the necessity of attaching elbows, etc. The suction has two openings, one on either side of the valve head; either or both can be used.

The Motor.

The motor is a standard National four-pole enclosed type. The frame of the motor is a cast steel housing, well proportioned in metal and accurately finished. It is made in one piece and extended in both directions to form a box-shaped covering for the armature and field coils. The pole pieces are an integral part of the frame with well machined pole faces. Particular attention is invited to the brush gear primarily in the matter of insulation. The external leakage surface of the insulation is 1¼ inches, compared with the ⅛ or ½-inch insulation provided by most manufacturers, absolutely insures immunity from insulation troubles. An insulating shield is provided between the bearing and commutator to prevent all possibility of the current flashing over between the two, due to wide fluctuations of voltage on the supply circuit.

The Governor.

The governor, supplied with portable compressor outfits, is a standard Type "N" oil pneumatic, which has fully demonstrated its absolute reliability and adaptability to the hardest kind of service.

Fig. 3. Governor with Cover Removed, Showing Details and Simplicity of Construction

The governor with cover removed is shown in Figure 3. The governor is extremely simple in design, has few working parts and occupies very little space. The essential features of the device are a cylinder, one and one-fourth inches in diameter which is connected direct to the main reservoir; a piston working in the cylinder is acted upon on one side by the pressure of the air in the main reservoir and on the other by the expansion of the operating spring. Movement of the piston throws a toggle joint over its center and causes a hammer to strike a switch-arm which makes or breaks the circuit to the air pump. The working parts are all contained in a box filled with oil which not only serves to keep the working parts lubricated but also extinguishes the arc caused by the breaking of the circuit. A tightly-fitting cover prevents leakage of oil.

With the portable outfits there is also furnished all necessary adjuncts, including a safety valve, an air gauge, piping and a very substantial and conveniently arranged hose container large enough to hold from 75 to 100 feet of hose.

Type "L" Water-jacketed Stationary Compressors.

These compressors are identical in every respect with the compressors just described, except that provision is made for a circulation of water around the cylinders and heads, keeping these parts at a minimum temperature and permitting the machines to be operated continuously.

All working parts of the compressor operate in a bath of oil. The other parts are automatically and continuously lubricated in a most thorough manner.

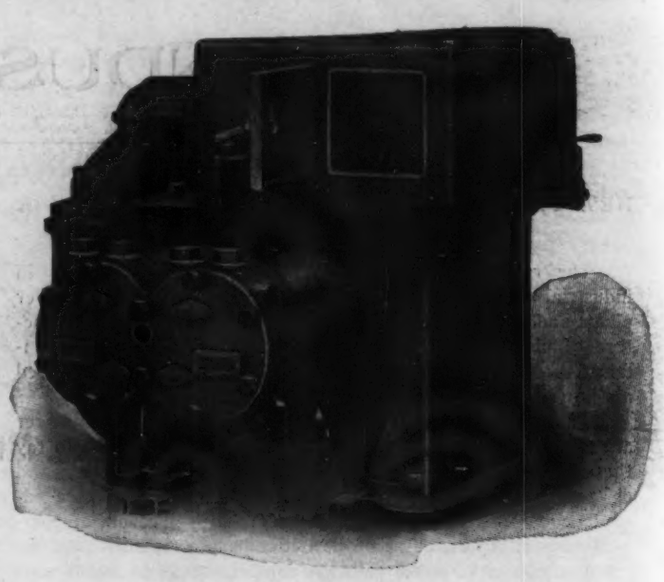

Fig. 4. Type "L" Water Jacket Compressor

With the water-jacketed types there is furnished a water governor which automatically cuts off the circulation of water as soon as the compressor is shut down. These governors are very simple and reliable in operation, and eliminate the possible neglect to turn the water off after stopping the machine, and in a like manner the water is admitted to the cylinders and heads when the compressor is started up.

Although the working parts of the machine are entirely enclosed and protected from injury, accessibility was carefully considered in the design, and every part can be quickly and easily inspected.

The portable compressor outfits are made in capacities of from eleven to fifty cubic feet of free air per minute; the water jacketed types are made in sizes ranging from twelve to thirty-five cubic feet of free air per minute. Detailed information on National Portable and Stationary Compressor Outfits is given in Bulletin 374, which will be sent upon request to the National Brake & Electric Company, Milwaukee, Wis.

ELECTRICAL MACHINERY IN SOUTHERN CALIFORNIA.

The engineering projects which have been undertaken on the Pacific Coast have almost invariably been carried out on a large scale. Long-distance electrical power transmissions, hydraulic power developments, or whatever the proposition which has been planned, have usually been brought to completion with such a degree of success that this section has come to stand as a pioneer in many kinds of engineering enterprises.

The section of country about Los Angeles, in the southern portion of the State of California, has assumed a particular interest in engineering matters from the large number of great development enterprises which have centered there. The city of Los Angeles itself enjoys the fruits of many of the engineering achievements which have been realized in its vicinity, not the least important of which is the supplying of its electrical service, light, power and traction facilities.

The Los Angeles Interurban Railway Company is one of five or six transportation companies forming what is known as the "Huntington Street Railway and Interurban System" in the Los Angeles district. This company and its associate companies have been undergoing rapid growth and extensions. The Huntington roads ramify Los Angeles County and those contiguous to it. Their power is taken from sub-stations distributed over the territory described. The number and capacity of these stations is constantly being increased, according to the direction of travel.

The motor-generators, etc., installed in these sub-stations, which were sufficiently large eighteen months or two years ago, are now being replaced by larger and more powerful machines, while the displaced smaller units are pushed further out on the lines.

Three Allis-Chalmers 1000 K. W. induction motor-generator sets, whose generators have a rated capacity of 1000 K. W. and motors 1500 K. W., have recently been ordered. In the course of time, if the traffic continues to warrant, the sub-stations which are now being equipped will either be increased in capacity by the addition of more 1000 K. W. units or these machines will in their turn be pushed further out and replaced by still larger units.

It is interesting to note that the power for the Huntington roads is taken from at least eight separate generating stations, both steam and water driven, all focusing in Los Angeles and being separated, in some cases, approximately 200 miles from each other. All of these stations work in synchronism.

The original power house for the system, which has been added to repeatedly in the growth of the enterprise, will doubtless be operated in the course of time as an auxiliary station. Among other units there are already installed in it three Allis-Chalmers 1500 kilowatt, 120 revolutions per minute, 50 cycle, 2300-volt engine-type generators, all driven by cross compound engines and constituting the latest addition to the equipment.

A NEW REFLECTOR-STALACTITE.

The Holophane Company, Sales Department, have recently placed on the market a new Reflector-Stalactite similar in construction and application to their well-known Pagoda ball which has been used so largely in the public buildings of this country.

Figure 1 shows one of these Reflector-Stalactites, the

Fig. 1

upper part consisting of scientific prisms, while the lower part is of ground glass, the whole being made in one piece, thereby uniting the effects of the frosted glass with the efficiency of

Fig. 2

Holophane prisms. This globe is made for a 3¼ inch holder, has a width of 6 inches and a height of 7¾ inches.

Figure 2 shows a similar type of Reflector-Stalactite having exactly the same dimensions in regard to holder and width, but having a height of 10 inches.

The globes in point of efficiency easily achieve the high standard set by the Holophane System. When lighted up, the result is very brilliant and altogether adds greatly to the artistic features of any place where used. The ground glass bottoms of these stalactites can be cut in a number of different patterns. In this way the beauties of cut glass are combined with the Holophane System of Illumination. Lamps of from 16 candlepower to 22 candlepower, are recommended for us in these globes.

Full particulars and prices may be had by writing to The Holophane Company, Sales Department, 227 Fulton Street, New York.

A SIMPLE METHOD OF CHARGING STORAGE BATTERIES.

The General Electric Company exhibited at the Automobile Show in San Francisco, February 18th to 25th, inclusive, two designs of mercury arc rectifier sets, a simple and economical device for transforming alternating current into direct current for charging automobile storage batteries.

Owners of electric machines will be especially interested in the standard charging panel for charging their storage cells. This outfit is shown in Fig. 1. Ordinarily the only circuit available at the home garage is that carrying the lighting current, which is almost universally an alternating current of electricity and not suitable for charging automobile cells.

The mercury arc rectifier changes this alternating into direct current economically and at the lowest initial cost.

The apparatus consists of a glass tube, the rectifier, mounted compactly on a Vermont marble panel with the necessary instruments and switches. The outfit is simple and reliable, and requires no attention. It takes up a very little space in the garage, and is ready for use when the switches are closed. No skilled attention is required, and the outfit can be operated by any person of ordinary intelligence.

A second outfit for charging ignition batteries is particularly valuable to owners of gasoline machines. This outfit is shown in Fig. 2. It is well known that storage cells are the most reliable type of battery for ignition work, but the inconvenience of having to take them to a public station to be charged, has not fostered their use.

The General Electric Company's rectifier set was designed to meet these conditions, and any one may conveniently charge a four-cell battery at a cost not exceeding twenty-five cents, using the direct current transformed by the rectifier from the lighting circuit.

The outfit is a miniature of the larger rectifier set, and has all its advantages.

ELECTRICITY IN ALASKA COPPER MINING.

The first practical application of electricity in Alaska copper mining has been inaugurated by the Reynolds-Alaska Development Company in the installation of a complete electrical equipment on La Touche-Iron Mountain mine on Prince William Sound. A waterfall capable of generating upward of a thousand horsepower has been harnessed, and the entire capacity eventually will be utilized.

The present equipment consists of a Pelton water wheel, two fifty-kilowatt Westinghouse generators, an electric hoist and pump, and four Temple pneumatic electric drills. The plant was put in operation early in November, and has since been running night and day, giving entire satisfaction. Thousands of dollars will be saved annually on the fuel item alone, and this, of course, means the cheaper production of copper.

Hood River, Ore.—Bids will be received by C. E. Markham until April 5 for the construction of Rorden and Dead Point Ditch.

NEWS NOTES

TELEPHONES AND TELEGRAPHS.

Sunnyside, Wash.—The Farmers Independent Telephone Association has installed a switchboard here.

Puyallup, Wash.—The Tacoma Industrial Company will erect a large brick building on South Main Street for their electric plant.

Spokane, Wash.—The Washington Water Power Company has increased its capital stock from $5,000,000 to $10,000,000.

Seattle.—The office of the United States Signal Corps in the Walker block will be moved to the new Arcade building when it is completed.

Tacoma.—The Northwestern Long Distance Telephone Company, of California, has appointed Roscoe Howard, of this city, as state agent.

Pullman, Wash.—The Breeze-Burgan Telephone Company, capital $3,000, has been incorporated by S. H. Breeze, Ed R. Young and others.

Puyallup, Wash.—The Pacific Telephone and Telegraph Company are reconstructing the entire Puyallup telephone system.

Seattle, Wash.—Superintendent Youngs, of the lighting department, states that work will begin at once on the proposed extensions to the system.

Indian Head, Sask.—The city is preparing to spend $25,000 on improvements to the electric lighting system. T. E. Donnely, mayor.

Portland, Ore.—The Pacific Light & Power Company, capital $50,000, has been incorporated by C. P. Houston, D. A. Houston and Alex. Sweek.

Meadows, Ida.—B. A. Chisholm and Edward Goodman are interested in the construction of an electric power plant at the falls of the Little Salmon, sixteen miles below here.

Spokane, Wash.—The Washington Water Power Company will lay 400,000 feet of underground ducts for its light and power wires the coming summer.

McCammon, Idaho.—A telephone company has been organized here with a capital of $10,000. A local system will be established connecting all nearby towns.

Olympia, Wash.—The Nesqually Power Company, of Tacoma, will construct a big electric power plant in Thurston County, on the upper waters of the Nesqually River.

Vancouver, B. C.—A contract has been awarded by the B. C. Tel. Co. to Miss E. W. Johnson for the erection of a new pole line between this city and Port Moody.

Richmond Beach, Wash.—The Richmond Beach Telephone and Power Company, capital $15,000, has been incorporated by Henry Parry and Ralph P. St. John.

Gig Harbor, Wash.—At Gig Harbor and Springfield, about fifty miles of country telephone line will be constructed, and a six-pair cable laid across to Point Defiance.

Tacoma.—The Pacific Telephone and Telegraph Company have about completed the cut over to Central Energy, at which work a large force has been engaged for the past several months.

Seattle, Wash.—Six wireless telegraph stations are to be established in Alaska. The stations are to be located at Nome, Fort Gibbons, Circle City, Fairbanks, Valdez and Sitka.

Renton, Wash.—The Independent Telephone Company will be ready to give service at this point soon. A 160 line Stromberg-Carlson common battery board and other central station equipment has arrived and is now being placed.

San Francisco, Cal.—Market Street is to be torn up from Twelfth Street to the ferry. The City Electric Company has notified the Board of Public Works of its intention to begin this week putting in a conduit for its wires along the thoroughfare.

Richmond Beach, Wash.—McGillivray & Piepot, Seattle, have been awarded the contract to construct about forty miles of telephone circuit for the Richmond Beaech Telephone and Power Company. The specifications call for standard construction, thirty-five poles to the mile.

Tacoma, Wash.—G. D. Grant has made application to the county commissioners for the right to construct and operate a system of waterworks, sewerage, gas pipes and electric light lines along and over Lake City Boulevard in Sections 9 and 16, Township 19 N., R. 2 E., W. M.

Great Falls, Mont.—At a largely attended and thoroughly representative meeting of the citizens here resolutions were adopted condemning the Rocky Mountain Bell Telephone Company for its alleged inefficient service, exorbitant rates and unfair wages paid to operators, who are now on strike.

Wallace, Ida.—G. Scott Anderson is organizing a company to be known as the Inland Power Company, capital $300,000. The incorporators are Stephen P. Wright, of Butte, Mont.; G. Scott Anderson, of this place; Maurice W. Bacon, William H. Hall, of Butte, Mont., and James J. Maloney, of Chicago.

San Francisco, Cal.—J. V. O'Brien, the manager of the Western Union office of this city, was married last week to Miss Ella Battles. Both have been connected many years with the company, their acquaintance dating from the time when they worked together as operators. Mr. O'Brien has risen from the position of messenger boy to that of manager.

Los Angeles, Cal.—A. H. F. Schaar, an electrical engineer of this place, has invented an instrument called the teleautoprint, with a keyboard like a typewriter, which both sends and receives messages, printing them automatically. It turns out a sheet resembling a typewritten message, no operator being necessary to do the work of receiving. The United States Wireless Printing Telegraph Company has been incorporated to handle the invention and put it on the market. The corporation is capitalized at $10,000,000. As soon as arrangements can be perfected a factory will be built.

San Francisco, Cal.—The arbitration committee which is to pass on the differences between the Southern Pacific and the Order of Railway Telegraphers is holding sessions in this city and will consider the subjects under discussion for two weeks or more. There are three points at issue: The contention of the men that train despatchers belong to the order and are subject to the rules of that body. The company holds a contrary position, arguing that the despatcher is an official of the company, as he gives orders to the telegraphers, signs the name of the division superintendent, and is a commanding officer.

The second point is "seniority." The men assert that the company should give the oldest man in the service a good station when a vacancy occurs. The company protests that

it wants to be able to select its representatives from any branch of the service it chooses, not confining its choice to telegraphers.

The last point is the question of hours and wages. The men want an eight-hour day and an increase in the present schedule. This, it is said, can be adjusted easily.

Oakland, Cal.—Extension of the block signal system out of Oakland is planned by the Southern Pacific Company and all the work of equipping the lines with the most approved form of safety devices is being carried out as rapidly as men and material can be secured for that purpose. The main lines, over which the heaviest traffic is sent, will be the first to receive attention, after which the other branches will be provided with apparatus, until within a few years the entire Southern Pacific will be operated in the most approved manner and with the risks attending human fallibility reduced to a minimum. Arrangements have been made for the equipping of the route from Elmhurst to Santa Clara, from Elmhurst to Niles, and from Niles to San Jose. From Niles eastward the block signals will be placed along the track as far as Tracy. At present considerable material has arrived at Niles and with the coming of favorable weather gangs will be put on with orders to rush the work of erection.

ILLUMINATION.

Yuma, Ariz.—An ordinance has been adopted granting to Seth Hartley permitting him to construct and maintain a gas plant for the city.

Azusa, Cal.—William Gard, representing a company of Pasadena investors, is in town looking for a suitable location for a gas plant. It is his intention to install a plant that will cost $20,000.

Santa Fe, N. M.—Superintendent Arthur Trelford, of the Territorial Penetentiary, states that an electric light and power plant for that institution could be established for about $15,000. The subject is now being brought to public attention by the introduction and passage of a bill in the House of Representatives.

Folsom, Cal.—Some months ago the supervisors let a contract for lighting the streets of the city, but the work of installing the lights has been delayed because it was impossible to get some of the fixtures. These have been received and the contractor expects to have everything in working order within a week.

Corona, Cal.—A petition has been presented to the Town Trustees asking for better street lighting. The matter has been referred to the City Department with the request that the committee confer with the electric light company to ascertain the probable cost of a system of incandescent lights such as is asked for in the petition.

Kelseyville, Cal.—An ordinance has been passed by the Board of Supervisors granting to the Lake County Electric Power Company the franchise and privilege of erecting and maintaining poles and stringing and maintaining wires for the purpose of transmitting and distributing electricity for the purpose of producing light, heat and power along certain streets in the county.

Oakland, Cal.—By the collision of an oil barge with the Oakland Gas, Light and Heat Co.'s wharf last week an electric salt water pumping plant was seriously disabled, causing a great reduction of gas pressure. Lack of water temporarily crippled the gas works, and the auxiliary service could not be used as it was undergoing repairs. An official complaint has been lodged by Mayor Mott against the company.

Alameda, Cal.—Superintendent Joseph B. Kahn of the Municipal Electric Light Department, has discovered that the wire supplying lighting current to seventy-five incandescent lamps in the houses of the Bay Shore Athletic Club, at the south end of Ninth Street, were tapped before the current entered the meter, and that as a consequence the city has been defrauded out of payment for the current. How long this condition of affairs has existed is not known, and it cannot be discovered who did the wire tapping. Kahn has ordered the supply of juice to be cut off from the club house, and it is probable that the matter will be investigated.

Napa, Cal.—The Napa Valley Power Co. has filed articles of incorporation, the project being, not as was first believed, an extension of the Bay Counties Power Co. from Napa, but an effort on the part of the Calistoga plant to extend its line southward and gain control of the entire valley north of Napa. The plant of the Calistoga Electric and Power Co. has been purchased by the new company, which has Harry M. Pitman, T. B. Pitman and G. S. Cutler for its directors. The new company is making a hard fight for the privilege of supplying St. Helena with light and power. The St. Helena Board of Trustees has again refused the offer of the St. Helena Gas and Electric Co. to pay a twenty-five per cent. raise for service to 12:30 a. m. at a meeting last week, and Mr. Pitman assured the Board that his company would guarantee a twenty-four hour service at a far cheaper rate. He has secured the consent of the Board to advertise for bids for the sale of an electric light franchise. The franchise will be put up in about thirty days, and Mr. Pitman promises to have current running into the town ready to be used within a month after that. The local plant uses oil to generate its power, and is owned principally by local residents.

TRANSPORTATION.

Merced, Cal.—Work is being rushed on the Yosemite Valley Railroad by a force of 1,500 men. The road is now being built from Merced to the park line, and the track is completed to Fox Creek within fourteen miles of the terminus. By the end of April the road will be ready to take passengers to the park.

Woodland, Cal.—There is a rumor about that something will soon be done in the matter of the electric road franchises secured by Captain Forsman for the construction of a line from Capay Valley to Elkhorn. It is asserted that a well-known railroad builder has become interested in the project and that he recently investigated the situation.

Martinez, Cal.—The East Shore and Suburban Electric road has commenced operations on the extension of its line to Point Orient. The extension has been talked of for months. It is expected that the road will be in operation within ninety days. The line will run past the quarries of the San Pablo Quarry Co., the winery of the California Wine Association and the can factory operated at Point Orient by the Standard Oil Co.

San Francisco, Cal.—Negotiations for the transfer of the holdings of the Eureka Transit Company were concluded last week and the control passed to George Heazelton of this city. The road formerly belonged to George Bull and associates. At present the line is twelve miles long. The plans of the new owner include an extension of fourteen miles around Humboldt Bay to Arcata. Later, if feasible, another extension will be built crossing Eel River at Scotia and running up to Ferndale.

Santa Cruz, Cal.—G. C. Pratchner, of the firm of Pratchner & Chadwick, has returned home after making a tour of inspection on foot of the Ocean Shore Railway between San Francisco and Halfmoon Bay. Contracts have now been let for all the roadbed between San Francisco and Halfmoon Bay, and this part of the road is now being rushed to

the exclusion of the road south of Halfmoon Bay, as it is planned to have trains running between these points by July 1st.

Redwood City, Cal.—The franchise owned by Clark & Bowie has been sold to the California Rapid Transit Co. The Board of Superivsors of this county sold two franchises to Clark & Bowie, one for an electric railroad to run from San Mateo to Halfmoon Bay and the other to operate a steam railroad. Very little work has been done on either. Clark and Bowie have been cited to appear before the Trustees and show cause why the franchises should not be revoked, and they have now disposed of them to the transit company.

Stockton, Cal.—A syndicate of Alaskan mining men, backed by a capital of $3,000,000, will commence at once the construction of an air line electric road from Stockton to Byron direct and from the latter point feeders to the Brentwood district on the north and to Livermore on the south. Byron Hot Springs, Bethany, and Herdlyn Station will be tapped and branch lines will be run throughout the southern end of the county. Double-track steel bridges will be built over the San Joaquin, Old and Middle Rivers, and at Old River large docks will be constructed, from which it is proposed to ship grain and hay and other produce to San Francisco. From the junction of the line and Old River a branch will be run to Oakley and Knightsen, and possibly to Antioch.

Berkeley, Cal.—Purchases of land at the stone culvert, which crosses Cardonices Creek at the point where Hopkins and Grove Streets meet, by persons acting for the San Francisco, Oakland and San Jose Railway have been followed by the report that the Key Route depot in North Berkeley will be established at that point. The route along Walnut Street has apparently been abandoned and the Sacramento Street line been closed as the means of access to the northern part of the city. The new Sacramento Street line will cut off from Fortieth Street, in Oakland, at California Street, and will come up California to a point near University Avenue, where the line will swing over to Sacramento Street.

TRANSMISSION.

Compton, Cal.—An ordinance has been adopted granting to G. R. Fulton the right to maintain poles and wires and other apparatus for use in furnishing electrical energy for lighting and heating purposes along the streets of Compton.

Folsom, Cal.—Wm. Muir, of Sacramento, has men at work building a dam below Colfax Bridge, on the North Fork of the American River. He and a party interested with him are going to put in a $500,000 electric plant this summer at the junction of the north and middle forks.

Guadalajara, Mexico—With a view of viewing the demand for additional election power in the Guanajuato mining district, the Guanajuato Power and Electric Company is taking up additional water rights along the Duero River in the State of Michoacan, and a second hydro-electric plant will be installed.

Los Angeles, Cal.—The first electric power plant on the Owens River aqueduct was definitely decided upon March 9th, and specifications were sent out for immediate installation. This power plant will be located at the mouth of one of the little streams at the intake, and will be put in operation at once, furnishing electricity to drive an electric dredger.

Quincy, Plumas Co., Cal.—J. W. Goodwin and associates, it is given out here, plan a big reservoir in Humbug Valley for power purposes. They recently acquired the Miller properties in that section for the sum of $90,000 and also stock in the Cataract Gold Mining Co., thus gaining control of a suitable river site on the North Fork of the Feather River.

Red Bluff, Cal.—There is again considerable activity displayed in obtaining water rights and power sites on Mill Creek, in the southern part of Tehama county. There are several opposing parties who have already filed on water rights there, and now come other parties, said to represent the Western Power Company, who have filed two claims for 10,000 miners' inches each to the waters of Mill Creek.

Oroville, Cal.—Brown, Wilson & Company are engaged in the development of great electric power plants on the north fork of the Feather River. The company proposes eventually to develop 420,000 horse-power of electrical energy from the stream. When the route of the Western Pacific Railroad, which follows the stream nearly to its source, was definitely settled, the properties of the mining company were acquired by the Great Western Power Company. On the bank of the river 525 feet below the outlet of a tunnel at Great Bend a power plant is being built. In this will be installed the largest electrical units ever constructed. The company contemplates much development in Plumas County at a point fifty miles north of the Great Bend plant.

Stockton, Cal.—Excavation for the foundations of the American River Electric Company's steam plant in the western part of town has been stopped by the high water, but it will be resumed before long. The object of building the plant is to have a reserve which can be thrown into use instantly in case anything should happen to the current from the mountains. The building will front eighty feet on Madison street and sixty-one feet on Lindsay. It will be fireproof throughout, the only materials used being steel and reinforced concrete. Electricity will be generated by a generator directly connected to a 3,000 horse-power Curtis turbine engine driven by steam from the boilers using oil fuel. The interior equipment of the structure will include a 40-ton crane.

Los Angeles, Cal.—The Edison Electric Co. has plans for the development of additional power. Its Kern River plant is nearing completion, and when it is in operation the company will have approximately 55,000 horsepower. Even this large amount will not be sufficient, because of the increased volume of business. At a meeting of the stockholders recently it was decided to add $1,200,000 to the capital, making the entire amount $11,200,000. This increase is necessary because of the volume of work being undertaken. The earnings of the company last year increased $460,000, while the expenses increased $200,000. The electric lighting business has increased twenty-seven per cent., the power business forty-five per cent., and the fuel business forty-nine per cent. The company proposes to place on the market 12,000 shares of common stock at $75.00 a share. It is the intention of the board of directors to make the first payment of dividends on August 15, 1907.

Cottonwood, Cal.—The seventy-five-foot false dam across Battle Creek, at the diversion point for the ditch that is to convey the water to the Northern California Power Company's power house site in Horseshoe Bend, is completed. The company has a force of seventy-five men at work. The false dam has been built just above where the permanent dam of stone will be constructed. The purpose of the false dam is to back up Battle Creek and turn the water to one side in a ditch, leaving the creek dry, so that work on the stone dam can be commenced on bedrock. The stone dam will be a work of great magnitude, being 133 feet high and 650 feet wide at the top.

There will be required 100,000 cubic yards of masonry, and the cost is estimated at $100,000. The power house site is five miles down the stream from the dam. The station will be capable of furnishing 15,000 horse-power. When all the company's proposed and existing plants are working they will command 25,000 horsepower.

INCORPORATIONS.

Tacoma, Wash.—The Tacoma Railway & Power Company will improve its Steilacoom line at once.

Seattle, Wash.—The Seattle Electric Company was granted a franchise on Prefontaine Place.

Palouse, Wash.—The Inland Electric Railway Company is building a depot here at a cost of $18,000.

Helena, Mont.—The Helena & Butte Electric Railroad Company has been incorporated with a capital of $3,000,000.

Eureka, Cal.—Certificate of change of principal place from this town to San Francisco has been filed by the Humboldt Transit Company.

San Francisco, Cal.—The Davenport Light and Power Company has been incorporated here. The capital stock is $10,000, shares $10 each.

Santa Barbara, Cal.—The Summit City Oil Company has been incorporated here with a capital stock of $500,000, of which $35 has been subscribed. Shares are $1 each.

Medford, Ore.—The Oregon Development Company will build an electric railway connecting Medford, Ashland, Jacksonville and Central Point.

Mt. Vernon, Wash.—Commissioners granted a franchise to the Superior Portland Cement Company to build an electric railway along the county road in sections 2, 3, 10 and 11, township 35, north of range 8.

North Yakima, Wash.—County Commissioners granted a franchise to the Yakima Inter-Valley Traction Company over county roads. The line runs south to Zillah, a distance of twenty-four miles.

Oregon City, Ore.—The Oregon City, Beaver Creek & Molalla Railway Company has been incorporated with a capital of $100,000, by Grant B. Dimick, Thomas T. Ryan and J. W. Sherwood, of Portland.

Red Bluff, Cal.—The Mill Creek Power Company has been incorporated by J. A. Whitehead, C. S. Barnes, F. R. Eldridge, M. O. Ballard and J. T. Cameron. The capital stock is $100,000, of which $1,000 has been subscribed.

Fresno, Cal.—With a capital stock of $25,000, the Central California Land and Water Company has been incorporated; $20,000 has been subscribed by C. M. Chalup, W. H. Peterson, C. E. Hamilton, H. C. Katze, and J. F. Summers.

Santa Barbara, Cal.—The Mountain Oil Company has been incorporated here with a capital stock of $500,000, shares at $1 each. The directors are H. A. Heller, J. Kolboth, C. P. Baird, J. Martin, J. B. Tait, and W. L. Leslie.

San Francisco, Cal.—With a capital stock of $1,000,000, the Williams Oil Company has been organized and incorporated by J. M. Wright et al. Fifty shares at $5 each have been taken.

Monrovia, Cal.—The Sierra Madre Telephone Company was incorporated here. The officers elected were W. E. Farnam, president; J. M. Baldwin, vice-president; F. N. Hawes, secretary; J. H. Baldwin, manager.

San Luis Obispo, Cal.—Articles of incorporation have been filed by the Western Pacific Oil Company, which is capitalized at $500,000. The directors are Peter Toggazini, V. H. Woods, E. W. Clark, J. Crocker and A. J. Martin.

Santa Barbara, Cal.—The Valentine Oil Company has just been incorporated with a capital stock of $300,000. The shares are $1 each, and $120 has been subscribed by F. H. Gates, J. P. Jacobs, L. S. Drumm, R. H. and Deane Laughlin.

Ventura, Cal.—The Mupu Oil Company has recently been incorporated here with a capital stock of $1,000,000, shares $1 each. The directors are T. A. and J. H. Slocum and Captain Fernald of Santa Paula, E. L. Jackson and Jas. B. Hanby, of Los Angeles.

Fresno, Cal.—H. E. Huntington is backing the Sierra Nevada Electric Company, recently incorporated here with a capital stock of $1,000,000. Shares sell for $100 each, and $5,000 has been subscribed by H. E. Huntington, W. G. Kerckhoff, A. C. Balch, J. C. Eastwood and F. H. Short.

San Luis Obispo, Cal.—The Hong Kong Oil Company, the promoters of which are V. L. Donati et al, of this city, has been organized in the law offices of Wm. Shipsey. Gin On was elected president; V. L. Donati, secretary, and Andrew Banks, treasurer. The directors of the company are V. L. Donati, W. Ging Fong, Chin Quon, and Lee Hing. The company will commence operations on the property acquired near the Pennsylvania Oil Company No. 8 well.

Reno, Nev.—Ambrose Madden, who has been an employee of the Carson-Truckee project, is the moving spirit in the incorporation of the Tempest Mining Co., for the sum of $200,000 under the laws of the State of Nevada. Associated with him is Paul C. Groth and Attorney Bird, of Fallon, and the property is located two miles southwest of Derby, and twenty-six miles of Reno. The main working shaft is down fifty feet, and will be continued to the 100-foot level, at which point crosscuts will be advanced to the vein.

OIL.

Fresno, Cal.—Secretary Jacob Clark, of the Twenty-eight and Oil City Petroleum Companies, has finished up the work of distributing the funds received from the late sales of the properties to the Standard Oil Company, and has sent to each of the stockholders the amount credited to his shares. It is the intention of the directors, who are the same men, to liquidate the corporations at once, and all new stock is being called in. The fund to be divided between the stockholders in return for giving up their shares is $850,000.

Bakersfield, Cal.—The first of the leases from the independent oil companies of the Kern River field to the Independent Oil Producers' Agency have been filed, although most of the documents were drawn up and acknowledged in 1904 and 1905. The form of the lease is very simple, and it conveys "the exclusive right, during the period herein stated, to bore, drill, mine, excavate and dig for and otherwise develop, collect, and obtain petroleum, asphaltum, bitumen, oil, coal and other minerals in and upon or under" the land described. The leases all run for a period of five years. Those filed so far are from the following companies: Alcides, Amazon, Caloma, East Puente, Euclid, Morton-Ritchie, Lakawanna, W. S. Morton, May, Nevada Consolidated, Potomas, Revenue, Sterling Oil and Development, Vesta, Merrill Crude, and Illinois Crude.

San Francisco, Cal.—Papers were signed last week in the office of Attorney Jesse Lilienthal, in the Flood Building, by which the 7,000-acre ranch of Mahoney Bros., the local contractors, in Santa Barbara County, was transferred to the Southern California Oil Syndicate, a corporation composed of London capitalists and Californa oil men. The price paid was not made public. The property is located two and a half miles south of Santa Ynez, and is in the oil belt. Development will soon be begun on a large scale.

Santa Monica, Cal.—The Santa Monica Oil, Gas and Mining Company is preparing to develop its property six miles northeast of here. A large force of men are building roads to the tract so that lumber and drilling machinery may be delivered.